Space Weather Technical Forecast

Issued on Friday, 25 February 2022 at 12:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing electron fluence possible. Very low chance of G1/Minor Storm and R1/Minor radio blackouts.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity is very low with two small and simple active regions on the visible disc, and no significant flares. No Earth-directed CMEs were observed in the available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, initially showed waning effects from coronal hole 56, before the apparent weak arrival of coronal hole 57. The wind speed was initially near 470 km/s, declining to around 400 km/s by 24/2200 UTC, then increasing again to reach 440-480 km/s since 25/0500 UTC. The density has been at mostly average levels throughout. The IMF, Bt, was initially very weak up to 4 nT, but increased steadily to reach up to 8nT for a time. The north-south component, Bz, varied very weakly initially, but increased to vary between +6nT and -6nT. Phi angle was variable to start, but settled largely positive (away from the Sun) around 24/1830 UTC. Resultant geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV) has been at normal background to moderate levels, peaking at 917 pfu at 24/1740 UTC. The corresponding 24-hour integrated electron fluence is well below the Active (1e8 integrated pfu) threshold with the 25/0000 UTC observation showing 2.74e7 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be very low, with a slight chance of C-class flares. Risk of M-class flares is very low currently, but with a slight increase as new regions rotate onto the disc in the coming days.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast. Three coronal hole high speed stream connections are expected during this period, with winds likely to reach around 500km/s at times. Geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active periods, and a very slight chance of G1/Minor Storm intervals.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy electron flux is likely to follow a erratic slight rising trend, with the possibility of exceeding the high (1e3pfu) threshold on diurnal peaks. Electron fluence is also forecast to follow a rising trend, but most likely to stay below the Active (1e8 integrated pfu) threshold. Confidence is low however.

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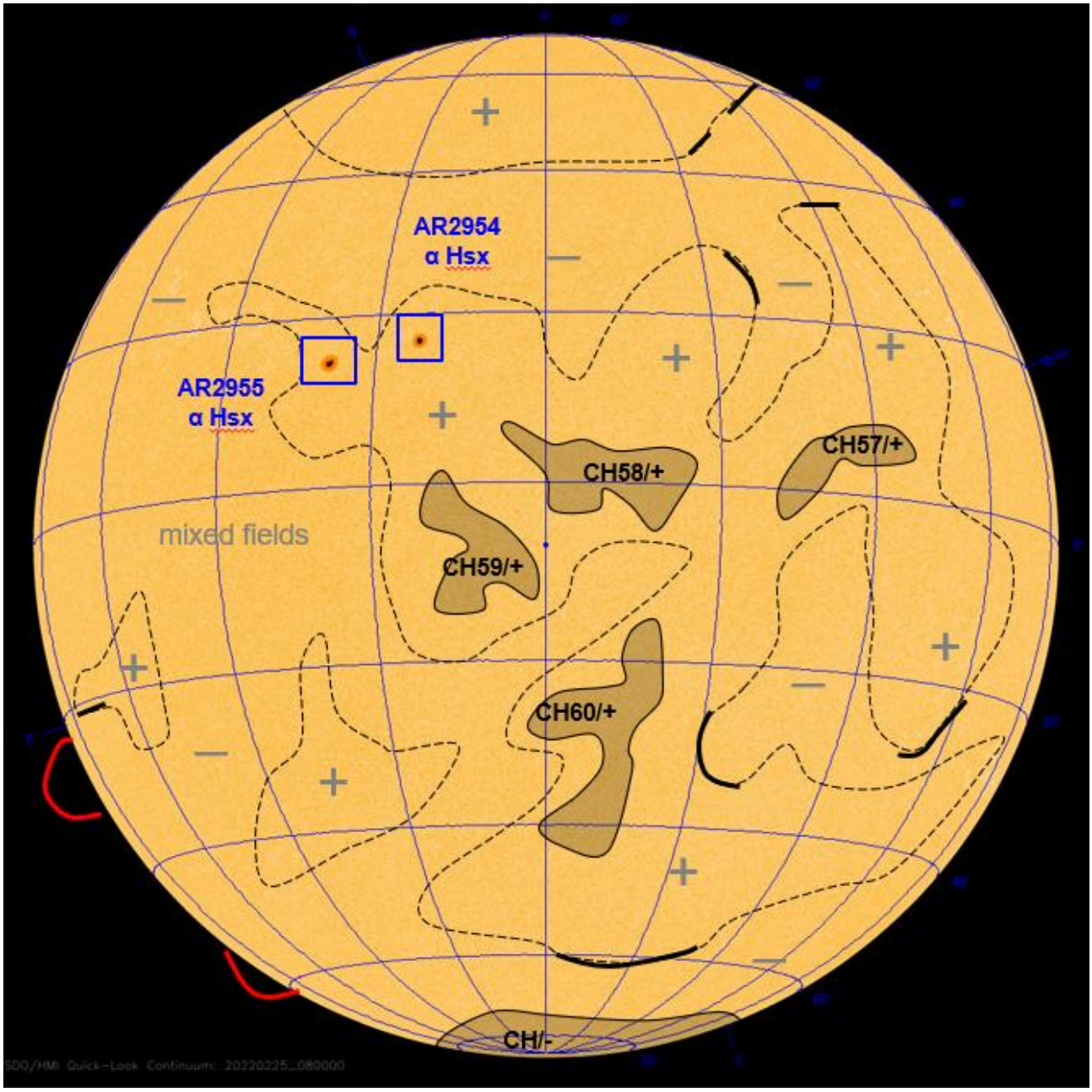
Figure 1. Solar Analysis Valid 25/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs forecast.
The high speed stream from coronal hole 57 appears to have connected with Earth earlier today, with wind speeds slightly elevated. A further connection with coronal hole 58 is likely on Days 2 or 3 (26-27 Feb). A connection with coronal hole 59 is then possible on Days 3 or 4 (27-28 Feb). Solar wind speeds from these holes are expected to reach around 500km/s at times, and it is likely that the effects will run into one another, making it difficult to tell the individual features apart when they arrive at L1. These features appeared weaker in imagery on the previous rotation, and wind speeds from the previous rotation were also contaminated by CME arrivals.

The upcoming coronal holes are all positive polarity, which are less favoured for a geomagnetic response at this time of year. As such, geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active periods, and a very slight chance of G1/Minor Storm intervals.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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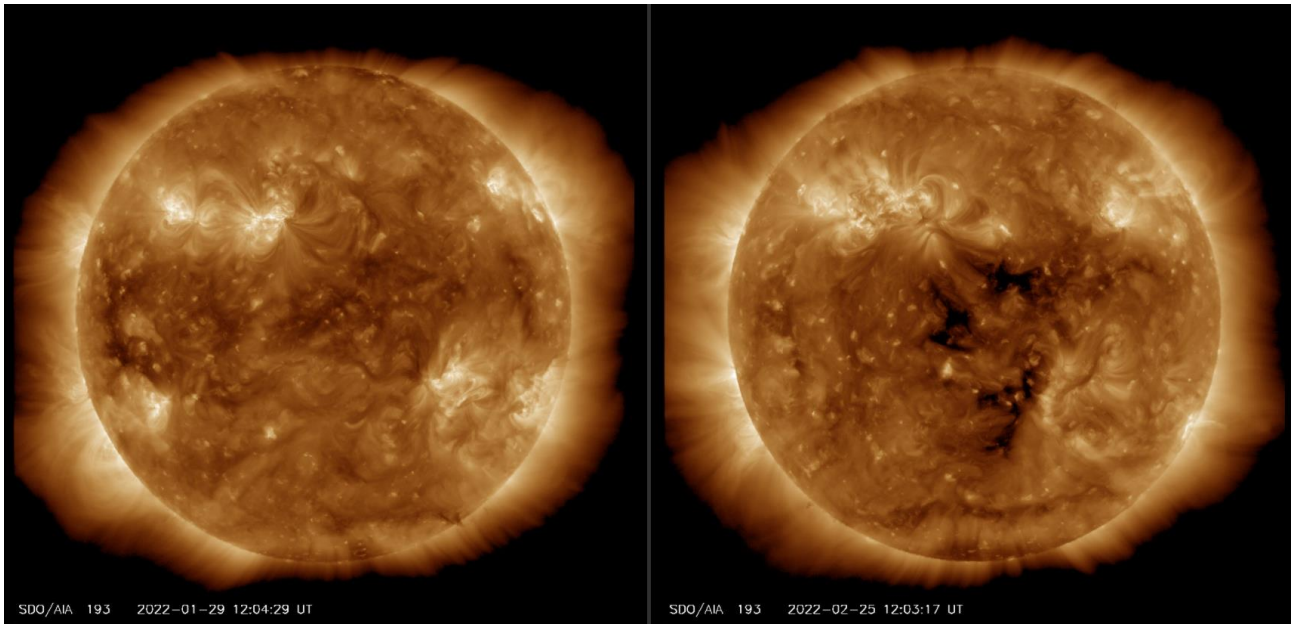
Figure 2: AIA-193 imagery from this rotation (right) and previous rotation (left). The coronal holes are more visible on this rotation than compared to the previous.



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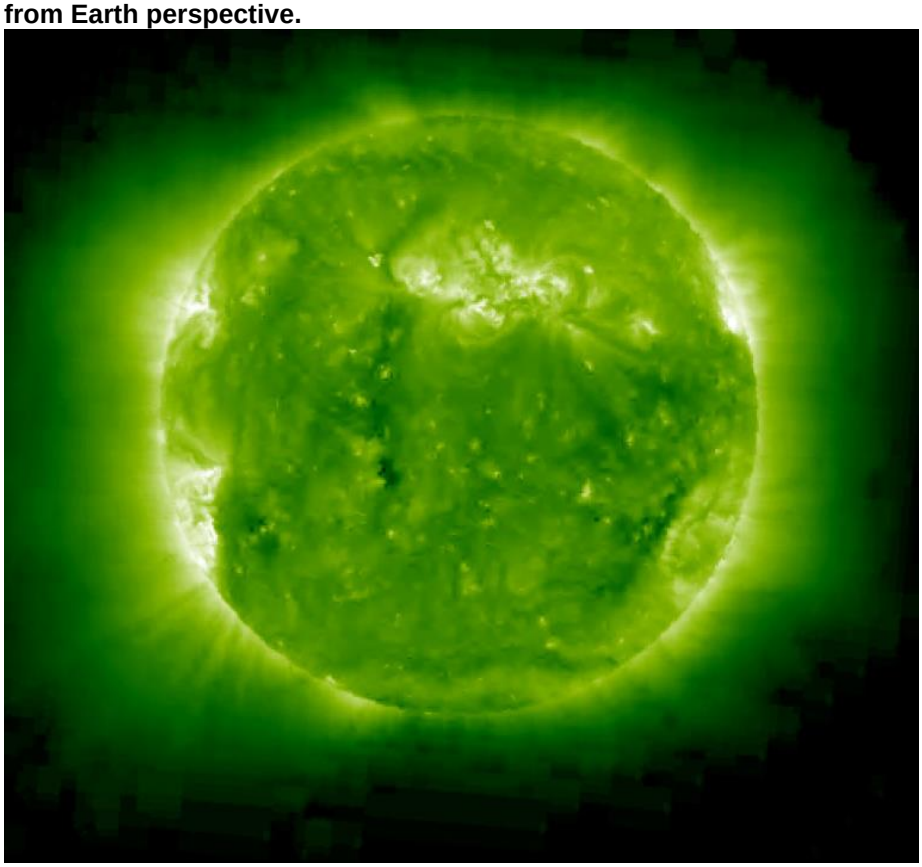
Radio Blackouts - X-Ray Flares:
Solar activity is very low, with two mature and apparently stable sunspots on the visible disc. AR2954 and AR2955 are both classified as Hsx/Alpha and have shown little activity. Further active regions are expected to rotate onto the visible disc in the coming days, with farside imagery suggesting that these could present a low risk of M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	2	3	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: STEREO-A EURI imagery showing some bright regions just over the eastern solar horizon from Earth perspective.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (10MeV) measured at GOES 16 is at background levels, and expected to remain at this level with no solar radiation storms occurring.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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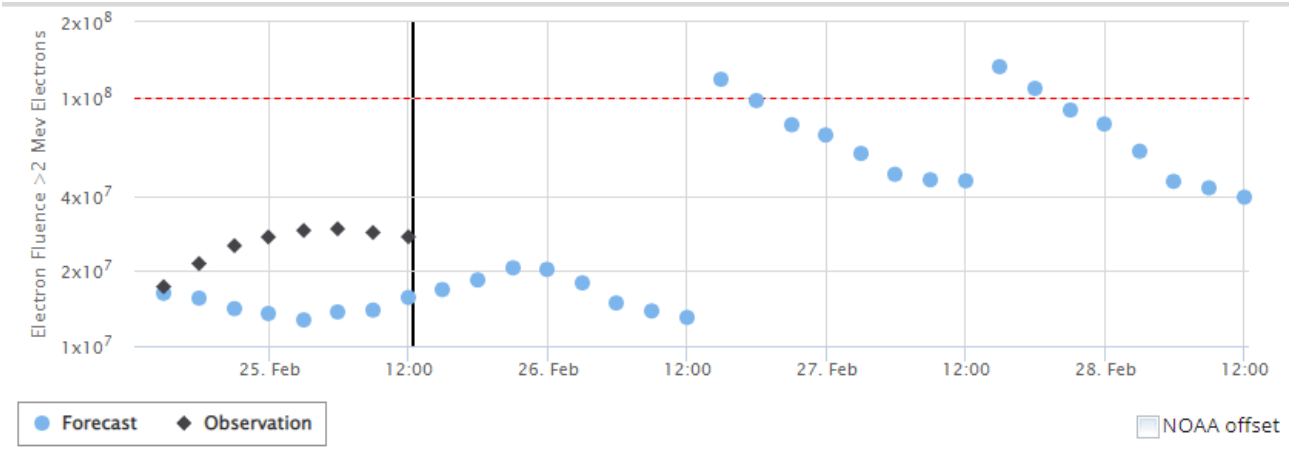
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) has reached moderate levels at the diurnal maxima in recent days, with an increasing trend in the diurnal peak. The arrival of a weak high speed stream from coronal hole 57 may suppress electron flux slightly today, with further high speed stream arrivals expected in the coming days. Some charging may occur from these high speed streams, but any CIR associated with these arrivals may also cause further suppression. As such, a general increasing trend is possible through the coming days, but with some variation in the peak values day to day.

Associated electron fluence is likely to rise if we do see some charging from the various high speed streams, but will probably stay below the Active (1e8 integrated pfu) threshold. Confidence is low however, due to the uncertainty surrounding the charging / suppression cycle of several high speed streams in the coming days.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	20	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 4: REFM is currently suggesting a declining trend, but it isn't currently assimilating the likely arrival of further high speed streams.



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